JACKSONVILLE HARBOR

Jacksonville Harbor Deepening Study

Discussion: Confined Blasting

March 12, 2013

PRESENTATION OUTLINE

1. Why Consider Deepening the Channel?
2. Where Would The Deepening Occur?
3. USACE Recommended Depth
4. JAXPORT Locally Preferred Plan (LPP)
5. What's The Timeline?
6. Confined Blasting Presentation

PRESENTERS:
Jason Harrah, Project Manager
Terri Jordan-Sellers, Senior Biologist

WHY CONSIDER DEEPENING?

Problem: Transportation Cost Inefficiency

Navigation concerns include two main problems:

- Insufficient Federal Channel Depths
- Restrictive Channel Widths and Turning Basins

Opportunity: Reduce Transportation Costs

- More Efficient Transportation of Cargo
- Increased Navigational Safety
- Opportunity to Capitalize on Larger Vessel Calls

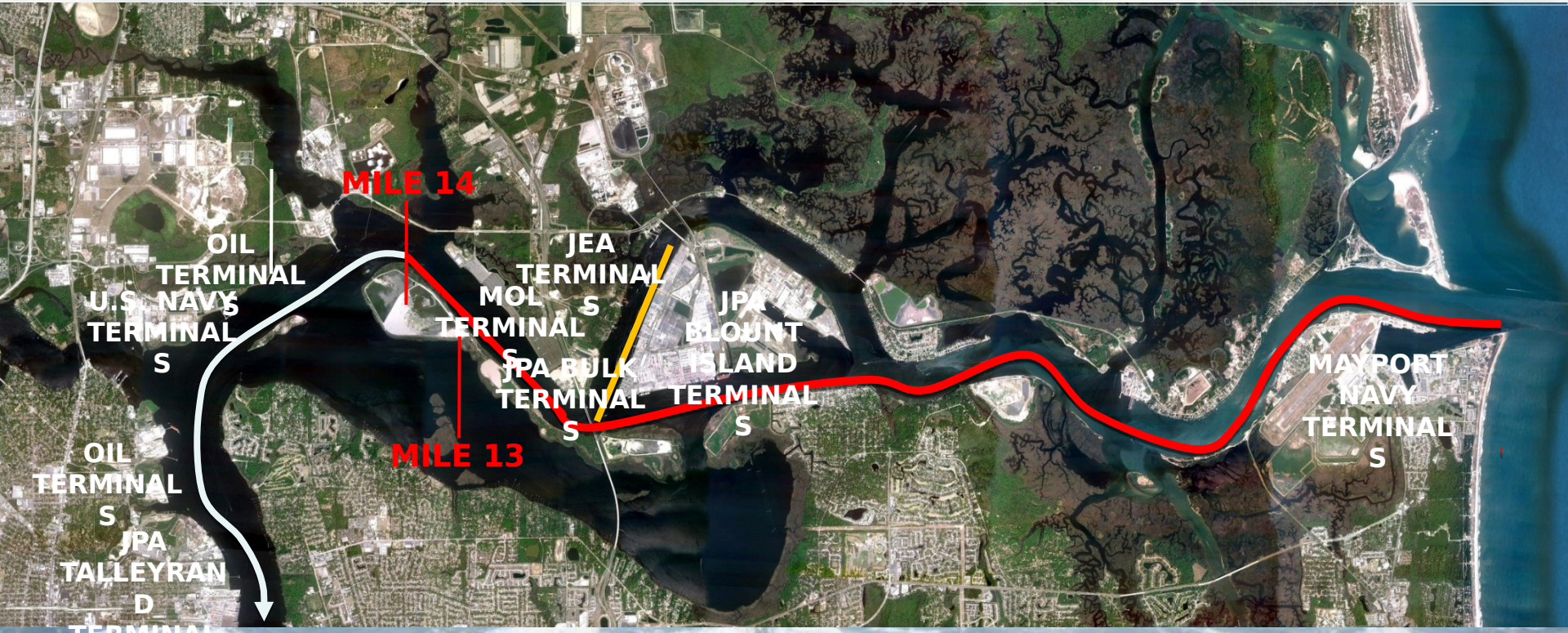
WHERE WOULD DEEPENING OCCUR?

Note: Not all areas of deepening require blasting

Segment 1: Entrance Channel to Mile 14 (Reduced to ~ Mile 13)

Segment 2: Mile 14 to 20 (eliminated)

Segment 3: West Blount Island Channel (Cuts F&G) (eliminated)



JAXPORT
JACKSONVILLE PORT AUTHORITY

DISCUSSION ON CHANNEL DEPTHS

USACE Recommended Depth – 45 feet

- Provides transition to larger vessels
- Port improvements needed beyond 45’

JAXPORT Locally Preferred Plan – 47 feet

- Must be approved by Assistant Secretary of the Army (Civil Works)
- Additional depths beyond 45’ paid 100% by sponsor
- Benefits are seen beyond 45’ – however cost growth

  is significant

PROJECT TIMELINE

President's "We Can't Wait Initiative"

ACTIVITY	DATES
Completion of Draft Report w/SEIS	April 2013
Concurrent Reviews: Public, Legal, Agency Technical Review, Policy (Division and Headquarters), Independent External Peer Review	May - July 2013
Division Engineer Approval *Design Initiated*	October 2013
Civil Works Review Board	December 2013
Chief's Report	April 2014
Authorization/Funding/Construction	2015 ?

JACKSONVILLE HARBOR

Jacksonville Harbor Deepening Study

Confined Blasting:
Miami Harbor Case History

Presented by:
Terri Jordan-Sellers
Biologist, Environmental Branch
Planning Division

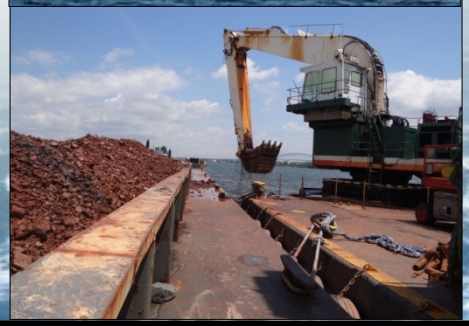
March 12, 2012

THE ISSUE

- How does the Corps and its contractors meet a Congressional mandate to deepen a port in an extremely environmentally sensitive area?
- What is sensitive?
  - Seagrass
  - Coral Reefs (directly offshore)
  - National Park to the south
  - Entire bay is “Outstanding State Waters”
  - State Aquatic Preserve
  - Critical Wildlife Area directly adjacent
  - Endangered, threatened and protected species
  - Highly aware citizenry and city overlooks projec site

CONSTRUCTION TECHNIQUES

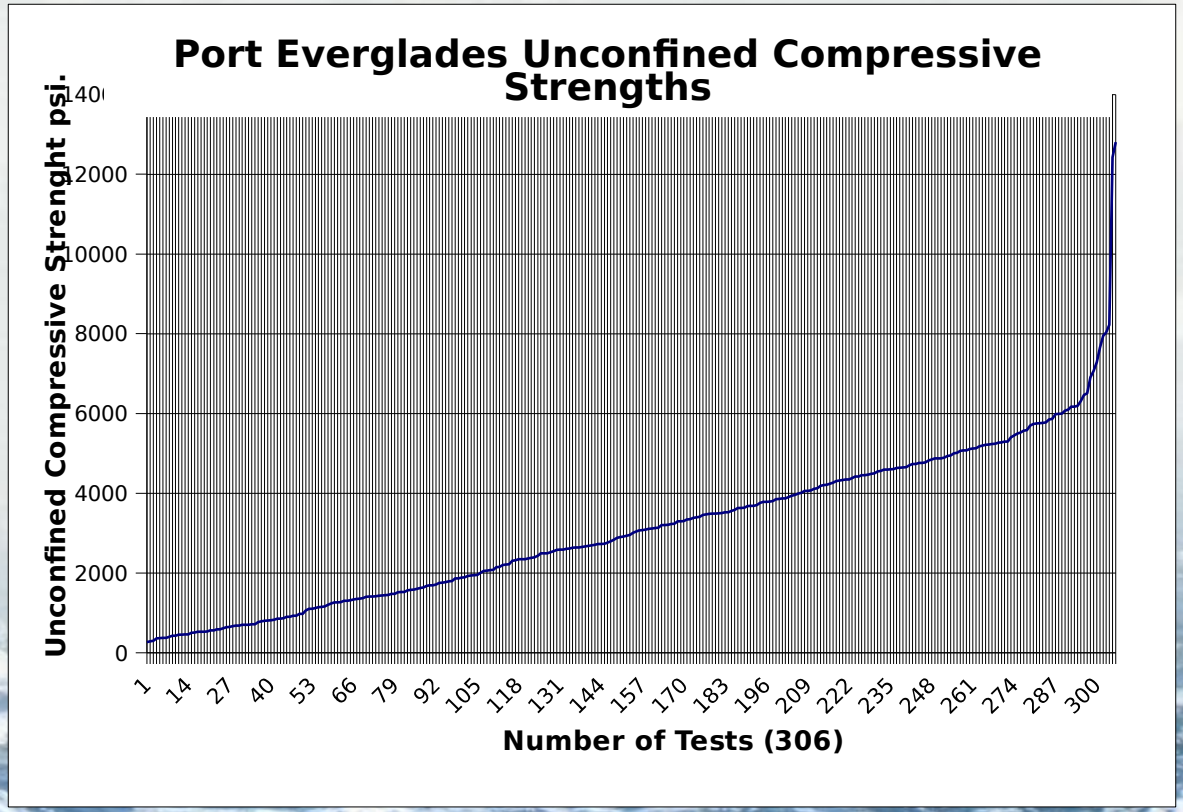
- Substrate hardness requires blasting in areas
  - Previous blasting in early 1980s
  - Confined blasting, w/stemming; "Navy diver" protection radii – (e.g., Port of Miami, May 2005/2013-2014)
- Cutterhead dredge
- Clamshell dredge
- Hopper dredge
- Bucket dredge



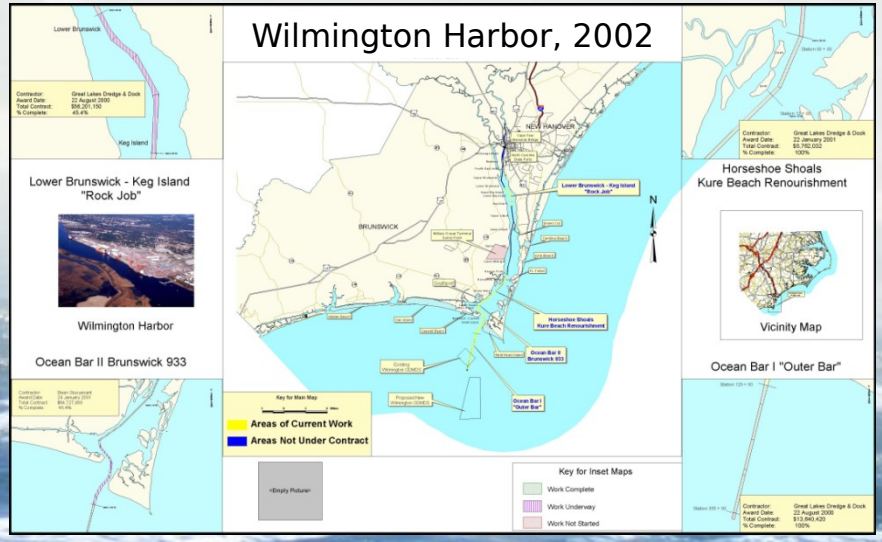
BLASTING REQUIREMENT

- The amount of blasting will be contractor dependent
- Some dredging equipment will not require as much pre-treatment of rock
  as others AND will be evaluated during the bid/proposal process

UCS TESTS FOR PORT EVERGLADES
RANGE FROM 266 PSI TO 12806 PSI

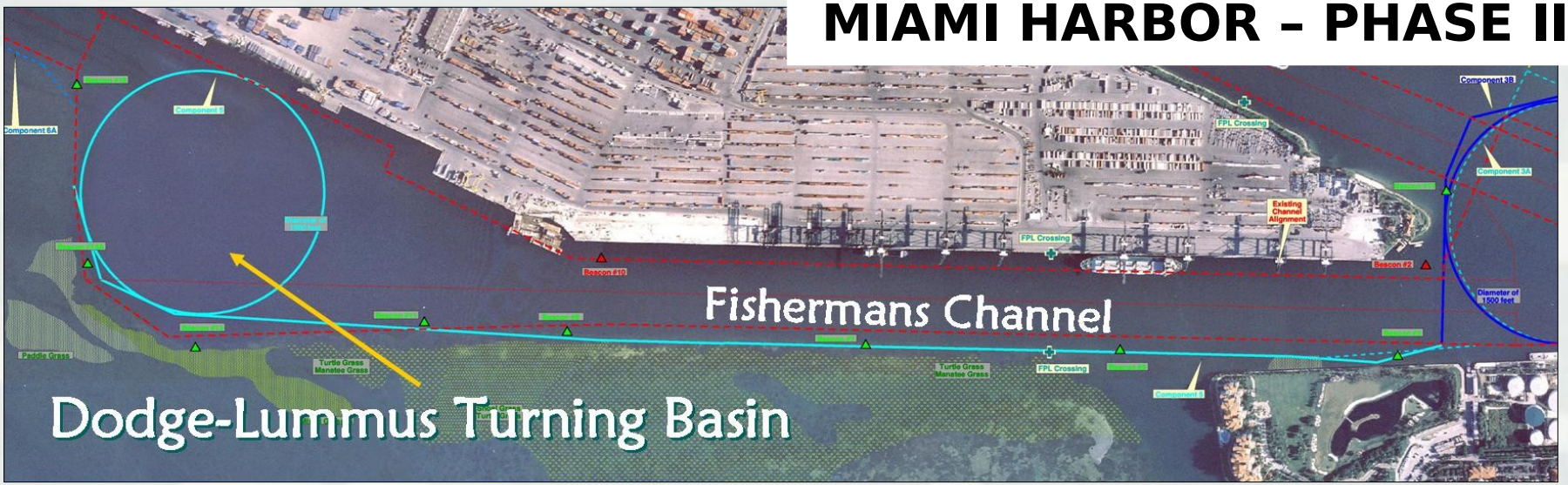


CONFINED BLASTING HISTORY



PROJECT AREA: MIAMI HARBOR

MIAMI HARBOR – PHASE II



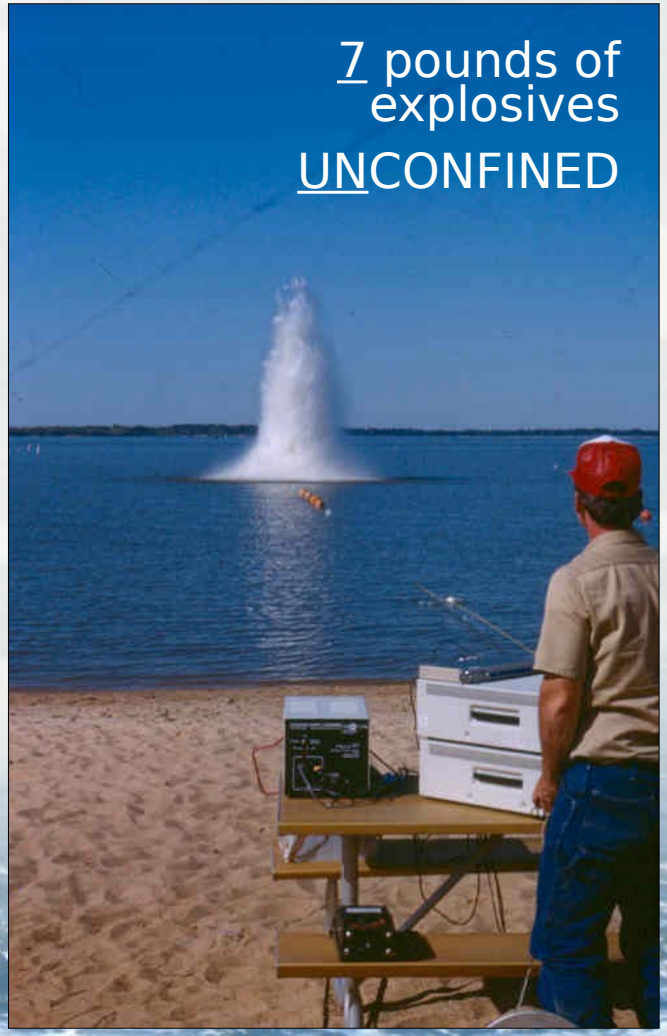
1989 EIS estimated 250 blasting events to pre-treat the rock in Fisherman's Channel

TYPICAL BLASTING PERCEPTION

SHIP-SHOCK OF USS WINSTON S CHURCHILL
(PHOTO COURTESY OF NMFS-OPR)

- Many think this image of a ship shock = confined blasting
- THIS IS NOT THE CASE

CONFINED vs. UNCONFINED BLASTING



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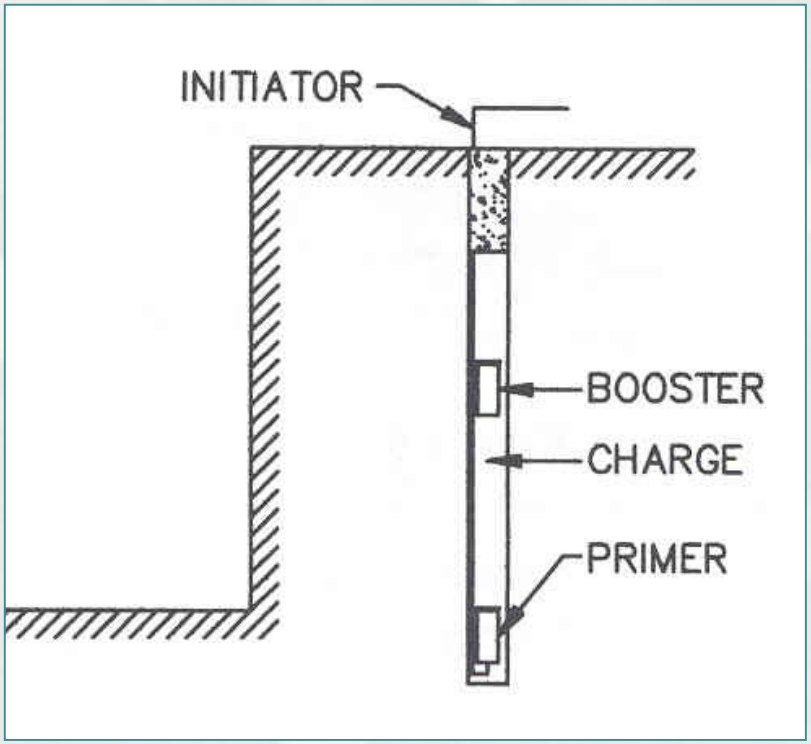
Confined underwater blasting can be used as a successful and efficient construction technique to pre-treat and crack hard rock, and with minimal impacts

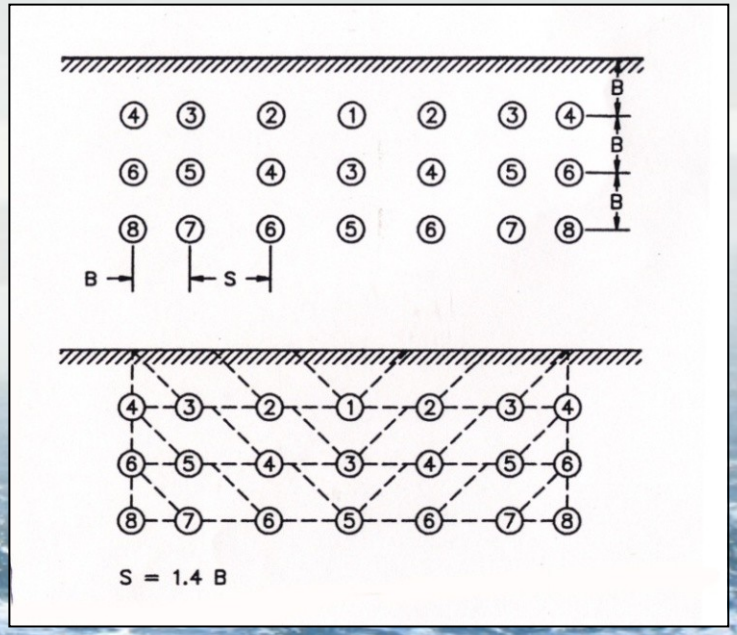
BLASTING OVERVIEW



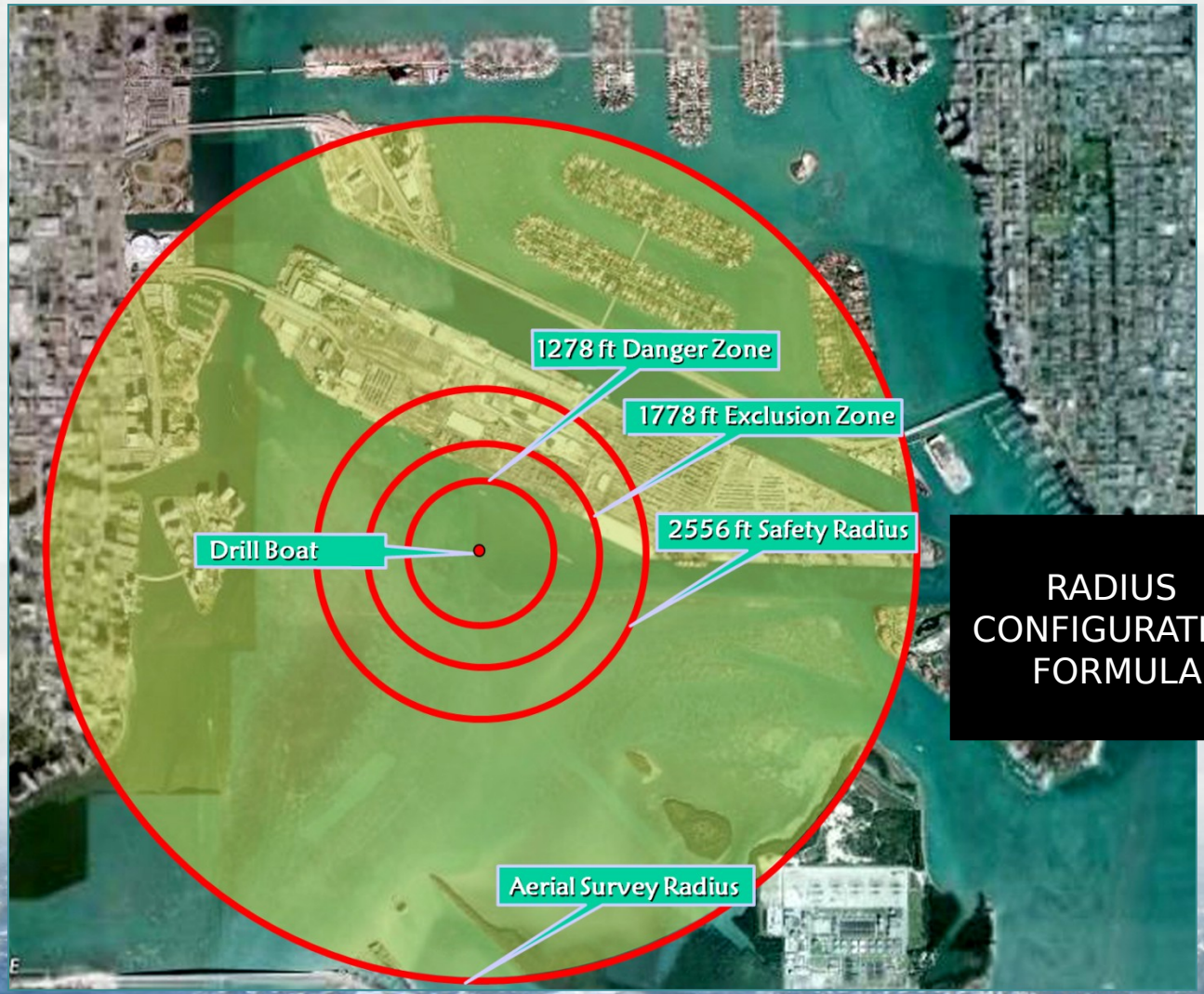
- Pressure Reduction ≥ 90%
- Smaller impact area

BLASTING OVERVIEW

- Delays
- One “shot”
- Channel closed 15 minutes before blast
- “All-Clear”



MONITORING ZONES



Average Zone Configuration for USACE Standard Underwater Blasting

R = 260 (cube root W)
R = Safety Radius
W = Weight of explosives

RADIUS CONFIGURATION FORMULA

- Danger Zone Radius = $260\ (\text{lbs/delay})^{1/3}$
- Safety Zone Radius = $520\ (\text{lbs/delay})^{1/3}$
- Watch Zone Radius = $3[260\ (\text{lbs/delay})^{1/3}]$

MONITORING METHODS

Observation Techniques and Data Collection

Aerial

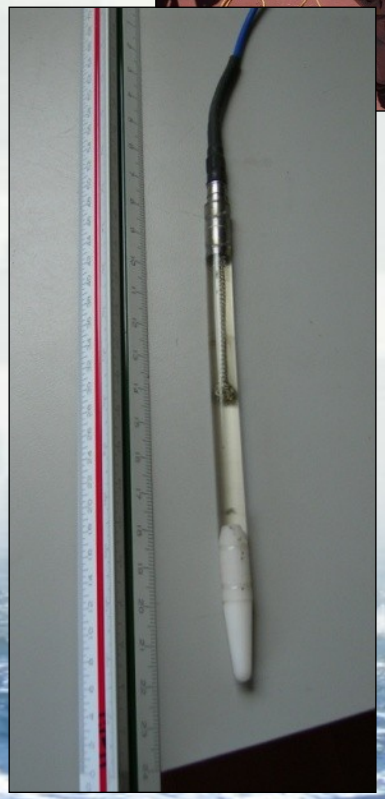
Drill barge

Two small boats on water – east and west of drill barge

ACOUSTIC/PRESSURE MONITORING

Lowering transducers into water

Oscilloscope

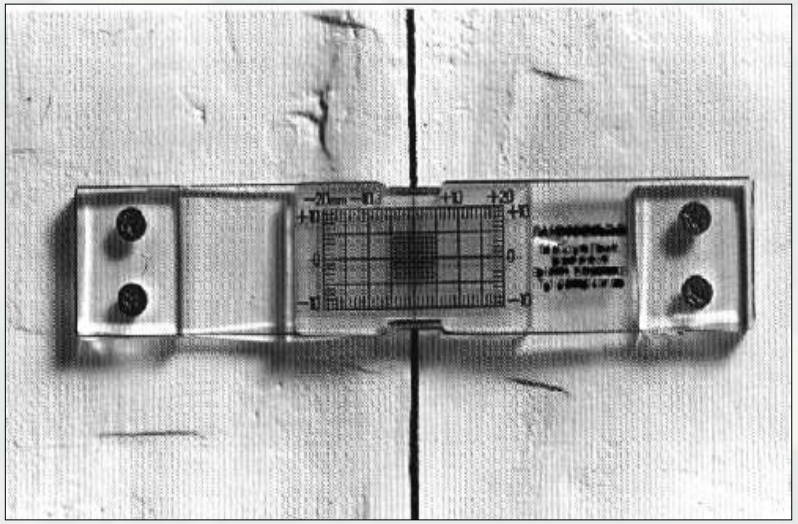


Hydrophone

Pressure Transducer

SEISMIC/VIBRATION MONITORING

- In an urban environment, such as the port, which is surrounded by commercial properties, utilities, and residential communities, protection of structures must be considered
- Once areas of the project requiring blasting have been identified, critical structures within the blast zones would be determined
- Where vibration damage may occur, energy ratios and peak particle velocities shall be limited in accordance with state or county requirements, whichever is more stringent



RECORDINGS OF A BLAST

August 2, 2005 - 16 Holes; 67 lbs/delay; 16 delays; 1105 lbs of explosive

RESULTS: ANIMALS OBSERVED AND DELAYS

186 ANIMALS OBSERVED		13 DELAYS TO ENSURE ANIMAL SAFETY	AVERAGE DISTANCE OBSERVED FROM ARRAY
	58 dolphins	4 (31% of total delays)	2000 feet
	110 Manatees	4 (31% of total delays)	3500 feet
	16 Sea Turtles	5 (38% of total delays)	500 feet

40 “Shots” in 38 days between June through August 2005

BLASTING EFFECTS: MARINE MAMMALS

450 POUND UNCONFINED BLAST

ZONE	MAX PRESSURE	LOCATION	NMFS TAKE THRESHOLD	LETHAL/ INJUROUS TAKE?	HARRASSMENT?
Danger Zone	23 psi	700 feet from blast	22 psi	No	Yes
Safety Zone	<23 psi	within zone	22 psi	No	No

NMFS: National Marine Fisheries Service

Blasting Effects: Fish Species

NO SWIMBLADDER:

- No effect to fishes without swimbladders - sawfishes (rays) and sharks

SWIMBLADDER:

- Pressure resulting in impacts to fishes with swimbladders

TYPE	PRESSURE	WHO
OPEN WATER *	14 psi	Wright & Hopsky (1998) Canadian Department of Fish & Oceans
OPEN WATER *	40-70 psi	Hubbs & Rechnitzer (1952)
OPEN WATER *	50 psi	Keevin (1995)
CONFINED **	14 psi	Hemper (2008)

* $260\ w^{1/3}$ ** $51\ w^{1/3}$

- The safe distance for fish (14-psi peak pressure) from a confined shot of 90 lbs/delay to fracture rock for channel deepening would be 570 feet. Fish within this 570-foot range would likely survive, considering the observations of Hubbs and Rechnitzer (1952) and Keevin (1995).

Without Swimbladder

With Swimbladder

RESULTS OF MONITORING: FISH

Fish Scare Clip

- 40 “shots” from June 25 through August 12, 2005
- Fish scare to lessen impact
- 23 w/fish impact monitoring by FWC
- Average fish recovered per blast:
  14 (*Range 3-38)
- No commercially or recreationally targeted species collected
  (e.g., snook, tarpon)

BLASTING EFFECTS: INVERTEBRATES

- A literature review of the effects of open-water blasts on invertebrates (including corals and arthropods) by Keevin and Hempen (1997) states:

  The results of all the studies reviewed indicate that invertebrates are insensitive to pressure related damage from underwater explosions. This may be due to the fact that all the invertebrate species tested lack gas-containing organs which have been implicated in internal damage and mortality in vertebrates. Underwater explosion produce a pressure waveform with rapid oscillations from positive pressure to negative pressure which results in rapid volume changes in gas-containing organs. Species lacking swimbladders or with small swimbladders are highly resistant to explosive pressures (Aplin 1947; Fitch and Young 1948; Goertner 1994).

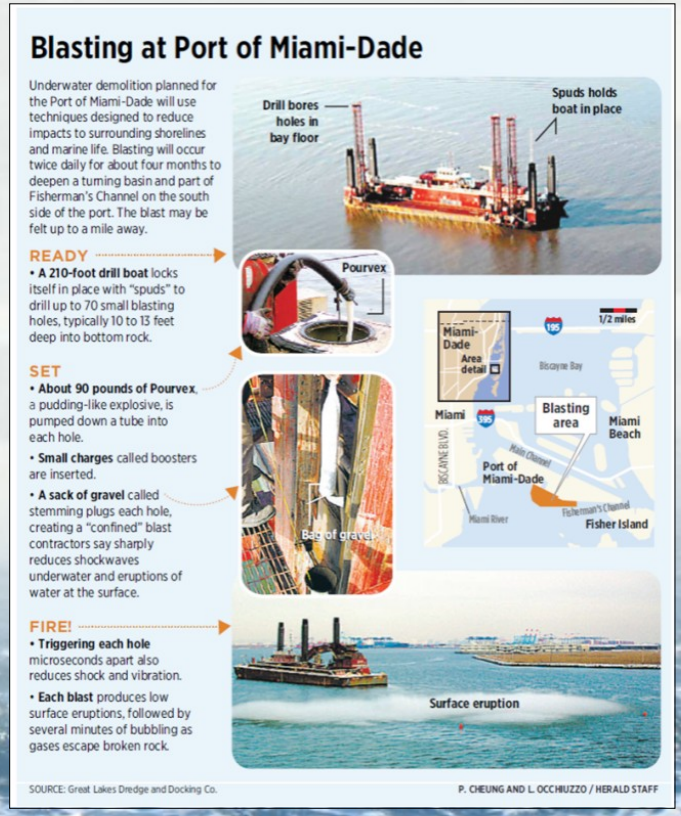
- NMFS has previously concurred with this determination at Miami Harbor (2011)

COMMUNICATION AND COORDINATION TEAM

- Corps of Engineers – Jacksonville District
- Port of Miami/Miami-Dade County
- Contractor and sub-contractors
- Federal Resource agencies (FWS, NMFS, EPA)
- State Resource agencies (DEP, FWC, CAMA)
- Local Resource agencies (DERM/PERA)
- Non-governmental organizations (NGOs)

COMMUNICATION AND COORDINATION

- Blasting Workshop to teach resource agency staff about blasting
  - On site with experts (biologist/geophysicist)
- Blasting workshop for the public hosted by contractor
- Visits to the worksite by resource agencies and interested parties (including the press)


Blasting at Port of Miami-Dade
Underwater demolition planned for the Port of Miami-Dade will use techniques designed to reduce impacts to surrounding shorelines and marine life. Blasting will occur twice daily for about four months to deepen a turning basin and part of Fisherman's Channel on the south side of the port. The blast may be felt up to a mile away.
READY
• A 210-foot drill boat locks itself in place with "spuds" to drill up to 70 small blasting holes, typically 10 to 13 feet deep into bottom rock.
SET
• About 90 pounds of Pourvex, a pudding-like explosive, is pumped down a tube into each hole.
• Small charges called boosters are inserted.
• A sack of gravel called stemming plugs each hole, creating a "confined" blast contractors say sharply reduces shockwaves underwater and eruptions of water at the surface.
FIRE!
• Triggering each hole microseconds apart also reduces shock and vibration.
• Each blast produces low surface eruptions, followed by several minutes of bubbling as gases escape broken rock.
Drill bores holes in bay floor
Spuds holds boat in place
Pourvex
Bag of gravel
Miami-Dade
Area detail
1/2 miles
Biscayne Bay
Miami
Blasting area
Miami Beach
Port of Miami-Dade
Fisherman's Channel
Fisher Island
Surface eruption
SOURCE: Great Lakes Dredge and Docking Co.
P. CHEUNG AND L. OCCHIUZZO / HERALD STAFF

MONTHLY MEETINGS ONSITE

- Held in Miami
  - More convenient location for most stakeholders
  - Conference call ability for those unable to travel
- Reviewed project progress and previewed upcoming events
- Made a major difference for all parties: maintained open communication lines between agencies/stakeholders, contractors, and Corps

WORKING TO ANSWER QUESTIONS

- Confined underwater blasting is “newer” to the resource agencies than unconfined (military ordnance)
- As a result of Phase II, there is now a large database of information regarding confined blasting, to successfully implement future confined blasting programs in equally sensitive areas

TAMPA PORT AUTHORITY

PUBLISHED, PEER-REVIEWED LITERATURE AND PRESENTATIONS

- Hempen, G., T. Keevin and T. Jordan. 2007. "Underwater Blast Pressures from Confined Rock Removal during the Miami Harbor Deepening Project." Feb 2007.
- Jordan, T.L., K.R. Hollingshead and M.J. Barkaszi. 2007. "Port of Miami Project. Protecting Marine Species During Underwater Blasting." Feb 2007
- The Ocean Sciences Conference – special session on acoustics – Honolulu, HI – Feb 2006
- 16th Biennial Conf on the Biology of Marine Mammals – San Diego, CA - Dec 2005
- 15th Biennial Conf on the Biology of Marine Mammals – Greensboro, NC - Dec 2003
- Press articles and interviews – National Public Radio; Comcast Newsmakers; USA Today; Miami Herald; Jacksonville Times-Union

CONCLUSIONS

Confined underwater blasting can be used as a construction technique to crack rock, with minimal impacts to marine organisms living in the project area when proper monitoring and safety precautions are established protocols from the beginning of project planning

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